Remarks/Arguments begin on page 14 of this paper.

An **Appendix** including amended figures is attached following page 31 of this paper.

REMARKS/ARGUMENTS

A final rejection was issued in relation to the above referenced application on July 15, 2003. Arguments were submitted in response to the Final Rejection and an Advisory Action dated September 22, 2003 indicated that the request for reconsideration had been considered but did not place the application in condition for allowance. To assist in the preparation of a Request for Continued Examination and an amendment, the Examiner and the Examiner's supervisor were kind enough to grant applicants an interview. A summary of the Final Rejection, a summary of the interview and a discussion of the above amendments are presented below.

Summary of the Final Rejection

Claims 56 - 66 and 71 - 84 are currently pending in the above referenced application. In the Office action, the following rejections were made:

- all claims were rejected under 35 U.S.C. §112 on the basis that "the specification does not describe an electronic device having an electrically connection between the carbon containing layer and the electronic device."
- claim 70 was also rejected under 35 U.S.C. §112 on the basis that the recitations in the claim "related to 'circuit traces' and 'a trace on the layer of electrically conductive material' were also not supported and described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention."

- claims 56-61, 64-68 and 71 were rejected under 35 U.S.C. §102(e) as being anticipated by U.S. Patent 4,888,247 to Zweben et al. (the Zweben et al. patent);
- claim 62 was rejected under 35 U.S.C. §103(a) as being obvious in light of the Zweben et al. patent; and
- claim 63 was rejected under 35 U.S.C. §103(a) as being unpatentable over Zweben et al. in view of U.S. Patent 5,326,636 to Durand et al.

Summary of interview

During a telephone interview conducted on November 3, 2003, the rejections made under 35 U.S.C. §112 were discussed with the Examiner Ling Xu and her supervisor Deborah Jones. Both Robert Green and David Bailey participated on behalf of the applicants. During the discussion, portions of the specification describing a printed circuit board in which a layer containing carbon forms part of the circuit within the printed circuit board were discussed. These portions included: page 5, lines 18-20; page 6, lines 7-9; page 23, lines 8-14 and page 25, lines 5-6. Upon review of the specification, the Examiners suggested amending the specification to more clearly call out the features illustrated in FIG. 10. The Examiners also considered claim 70 and indicated that similar claim language directed towards a printed circuit board in which a layer containing carbon acted as part of the circuit (e.g. the power or ground plane) would be likely to satisfy 35 U.S.C. § 112.

During the discussion, reference was made to U.S. Patent 4,888,247 to Zweben et al. The discussion of U.S. Patent 4,888,247 occurred as part of a discussion of the prosecution

history of the application and substantive discussions were not conducted concerning the content or teachings of this reference.

Summary of amendments to drawings and specification

Each of the amendments will be discussed in detail. Essentially the original specification has been amended to draw together the various disclosures relevant to the printed wiring board (PWB) shown in FIG. 10. Therefore, FIG. 10 and FIG. 11A have been reproduced as FIG. 1A and FIG. 1B and a description of these figures has been inserted at the start of the section entitled "DETAILED DESCRIPTION OF THE INVENTION".

FIG. 1A shows a multiple layer PWB having two electrically conductive laminates that include layers containing carbon. In addition, the various functional layers of the PWB (including the laminates) are connected via plated through holes. The only difference between the PWB shown in FIG. 1A and the PWB in FIG. 10 is that the PWB in FIG. 1A does not include the chimneys 128 shown in FIG. 10. The chimneys are not relevant to the connection of functional layers of a PWB and, therefore, were not included. FIG. 1B shows a process for constructing the PWB shown in FIG. 1A and is identical to FIG. 11A.

The original description of FIG. 10 relies heavily upon references to other embodiments. In particular, the structures and materials that can be used to construct the PWB 10'''' shown in FIG. 10 are described by referring to the structures and materials that can be used to construct the embodiment shown in FIG. 1. The view has been expressed that this mode of description is confusing, therefore, FIG. 1A is described using

the basic overview description provided for FIG. 10 and incorporating into that description the relevant disclosures made in relation to FIG. 1. The description of the process shown in FIG. 1 is almost identical to the description of the process shown in FIG. 11A with the exception that the discussion of chimneys has been excluded.

Applicants submit that the amendments to the original specification do not introduce new matter. As can be seen from the discussion below. The vast majority of the amendments are modified quotes from the original specification. Portions that are not quotes are typically statements of the meaning that would be attributed by one of ordinary skill in the art to a term used in the original specification.

Support for amendments to specification

The first sentence is simply a description of what is shown in FIG. 1A:

> Referring now to the drawings, a printed wiring board ("PWB") 10a in accordance with an embodiment of the present invention is shown in FIG. 1A.

The second sentence is a modified quote from page 22, lines 10 - 11 (amendments shown):

> The PWB [[10'''']] includes a first laminate 120, and a second laminate 122, multiple layers of prepreg 124 and multiple layers of metal 126.

The next two sentences combine knowledge that would be known to one of ordinary skill in the art that a PWB includes a circuit that can be distributed over several layers of the PWB and a quote from page 1, lines 17 - 18 (quoted portion indicated):

> The PWB 10a contains circuits and is "used for mounting integrated circuits (ICs) and components". The term circuit is used to describe an electrically conductive path between two or more points. Individual layers of the PWB can include circuits and a number of circuits on several layers of the PWB can be connected to create an overall PWB circuit.

The next sentence is introduced in the amendment and states the meaning that would be attributed to the term functional layer by one of ordinary skill in the art. The term functional layer is mentioned in the original specification in relation to FIGS. 10 and 11A on page 23, line 10.

> The layers on which portions of the circuit of the PWB are located are often referred to as functional layers.

The next paragraph discusses the laminates used in the construction of the PWB. The original specification states that "the first laminate 120 and second laminate 122 are constructed

similarly to the laminate 12 of FIG. 1." Therefore, the description of the laminates quotes the portion of the original specification describing the laminate 12 of FIG. 1. The first sentence is a modified quote from page 5, lines 18 - 20 (amendments shown):

> ~~The PWB 10 includes a laminate 12 comprising~~The laminates 120 and 122 comprise a carbon containing layer 14 sandwiched between a first layer of metal or other electrically conductive material 16 and a second layer of metal or other electrically conductive material 18.

The next two sentences are a modified quotation of page 6, lines 7 - 9 (amendments shown). The statement that the laminates can be used as functional layers is merely a clarification of something implicit in the original specification. The original specification states that through holes enable connections to be made between functional layers and describes connecting through holes to functional layers. The fact that laminates that act as power and/or ground planes are functional layers is also something that would be known to one of ordinary skill in the art reading the original specification, because the use of the laminates as part of the circuit of the PWB, by definition, makes the laminates functional layers:

> ~~The laminate 12 is~~Both of the laminates 120 and 122 are electrically conductive, which enables the

> laminate to be used as a functional layer within the PWB. The functions that can be performed by the laminates include acting as a ground plane within the PWB, a power plane within a PWB or both a ground and power plane in the PWB where routing is used to electrically isolate portions of the laminate.

The following sentence is introduced in this amendment and informs the reader that suitable materials for constructing laminates are discussed later in the specification:

> Various examples of other laminate structures that can be used in accordance with the present invention to implement the laminates 120 and 122 are discussed below.

The original specification informs the reader that the layers of metal and prepregs shown in FIG. 10 can be constructed in a similar manner to the layers of metal used to construct the PWB 10 illustrated in FIG. 1 (see page 22, line 21 - page 23, line1). Therefore, the discussion of the layers of metal and the prepregs quotes extensively from the description of FIG. 1. The discussion of patterning layers of metal or other conductive material with electrical circuits is a modified quote from page 6 line 22 - page 7, line 5 (amendments shown):

> The layers of metal can act as functional layers in the PWB. In one ~~preferred~~ embodiment, the ~~third and~~

~~fourth~~ layers of metal or other electrically conductive material are patterned with electrical circuits. ~~For example,~~ [[e]]Electrical contact between ~~the third layer of metal, the electrically conductive laminate or the fourth layer of metal~~ the various layers of metal or laminates can result in the functions of the electrical circuits patterned onto the ~~third and fourth~~ layers of metal being interrupted.

The discussion of the use of prepregs to insulate layers of metal and the electrically conductive laminates is a modified quote taken from page 6, lines 21 - 22 (amendments shown):

~~The first prepreg layer 20 and the second prepreg layer 22~~ Therefore, prepregs are used to electrically insulate the electrically conductive laminates 120 and 122 and the ~~third layer of metal 24 and the fourth~~ layers of metal 126.

The description of the structure of the prepreg is a direct quote taken from page 6, lines 18 - 20:

A prepreg is a composite layer that includes a substrate or supporting material composed of fibrous material that is impregnated with resin.

The description of the dielectric properties of prepregs is a modified quote taken from page 9, lines 11 - 12 (amendments shown, note extensive list of materials excluded from quote):

> The prepregs are electrical insulators ~~. . .or any other prepreg~~ having dielectric constants less than 6.0 at 1 MHz.

The use of films as prepregs is a direct quote taken from page 6, lines 18 - 20:

> A prepreg may also be a film. A film is a type of prepreg that does not include a substrate but is instead a composite that only includes resins.

The next sentence is added by this amendment and simply informs the reader that materials that can be used to construct prepregs are disclosed later in the specification:

> Materials that can be used to construct prepregs in accordance with the present invention are discussed below.

The discussion of lined through holes establishing connections between functional layers of a PWB is taken from the description of FIG. 10 and the discussion of the construction of lined through holes made in relation to FIG. 11A. The first sentence of this discussion is simply a statement of the fact

that lined through holes (also known as plated vias) are widely used in the construction of PWBs:

> Often, the circuits within a PWB include plated "through holes" to establish connections between the functional layers of the PWB.

The next sentence specifically relates to the plated through holes in the PWB illustrated in FIG. 10 and is a modified quote taken from page 23, lines 8 - 10:

> In one embodiment, [[T]]the PWB 10a[['''']] [[also]] includes through holes 130 lined with electrically conductive material that are used to establish electrical connections between the functional layers in the PWB.

The next sentence is added by this amendment and is a statement of what one of ordinary skill in the art would understand to be a function of lined through holes. The sentence is also another way of expressing the statement quoted above that the lined through holes are "used to establish electrical connections between the functional layers in the PWB" (see page 23, lines 8 - 10).

> These lined through holes enable electrical signals to pass between circuits on the metal layers and/or the laminates.

The next sentence is also a statement of something that would be known to one of ordinary skill in the art. The fact that electrical connections can be established between the linings of plated through holes and circuits on layers of metal is also stated explicitly in U.S. Patent 4,318,954 to Jensen (the Jensen patent) at Col 3, lines 21 - 25 in relation to FIG. 1 of that patent. The disclosure of the Jensen patent is incorporated into the original specification of the above referenced application by reference in its entirety at page 2, lines 13 - 14.

> It is well known in the art that connections can be created between the electrically conductive linings of plated through holes and circuits patterned on a layer of metal by locating the plated through hole such that the lining of the plated through hole contacts a portion of the circuit patterned on the layer of metal.

The discussion of the creation of electrical connections between the lining of a through hole and a laminate is supported by the disclosure on page 25, lines 5 - 6 that "If a through hole does not pass through one of the filled clearance holes in a laminate, then the lining of the through hole is in electrical contact with the laminate."

> When a connection between a laminate and a plated through hole is desired, the through hole is simply drilled through the laminate at the desired location and an electrical connection is established where the electrically conductive lining of the through hole contacts the electrically conductive laminate.

The next sentence is added by this amendment and is merely the corollary of the fact that contact between the lining of a through hole and a circuit will establish an electrical connection. Applicants submit that the following would be known to one of ordinary skill in the art and readily inferred by one of ordinary skill in the art reading the original specification of the above referenced application.

> Techniques for avoiding electrical connections between circuits patterned on a layer of metal in a PWB and a plated through hole are well known in the art. Each of the options essentially involves designing the circuit routings and the locations of the plated through holes to avoid contact between the electrically conductive lining of the plated through hole and the circuit.

The next sentence discussing how to avoid connections between a laminate and the lining of a through hole is a direct quote from page 23, lines 10 - 14:

Where connections between the plated through holes and the first or second laminates are not desired, then an annulus of dielectric material 132 such as an epoxy resin with a dielectric constant less than 6.0 at 1 MHz can be used to ensure that an electrical connection does not exist between the laminate and the electrically conductive lining of the through hole.

The description of the process shown in FIG. 1B for constructing the PWB 10a is almost a direct quote of the description that runs from page 23, line 15 to page 25, line 6 of the process shown in FIG. 11A (amendments shown):

A process in accordance with the present invention for manufacturing the PWB 10a[['''']] illustrated in FIG. 1[[0]]A is shown in FIG. 1[[1A]]B. The process 150 commences with the step 152, which involves constructing two laminates in accordance with the present invention ~~are formed~~ using any of the appropriate processes described below including the process ~~described above in relation to~~ illustrated in FIG. 2A. Power or ground regions are then patterned on the laminates in the step 154.

Once the patterning is complete, the laminates are subjected to oxide treatment in the step 156. After oxide treatment, clearance hole drilling is performed in the step 158. Clearance hole drilling involves drilling holes in the laminate of a first

diameter and filling the resulting holes with a dielectric material such as any of the resins described ~~above~~below with a dielectric constant less than 6.0 at 1 MHz. Prior to filling the drilled holes, they are inspected and cleaned using high pressure dry air.

Once the clearance holes have been drilled, the second lamination cycle is performed in the step 160. The second lamination cycle~~s~~ is similar to the second lamination cycle described ~~above~~below in relation to FIG. 2A. After the second lamination cycle, ~~chimney holes are drilled into the PWB in the step 162. Once the chimney holes have been drilled, the linings of the chimney holes are lined with a thermally conductive material in the step 164. Preferably, the thermally conductive material is copper. In other embodiments, any material with a thermal conductivity greater than 5 W/m.K can be used.~~

~~After the chimney holes have been lined,~~ circuits are etched onto the layers of metal that will be located within the interior of the finished PWB are patterned in the step 166 and then subjected to oxide treatment in the step 168.

Following the oxide treatment, the third lamination step is performed in the step 170. The third lamination involves aligning the two structures produced in the second lamination with additional prepreg layers to correspond with the layers of the

PWB 10a[['''']] illustrated in FIG. 1[[0]]A. The layers are then exposed to temperatures and pressures similar to those experienced during the second lamination cycle.

After the third lamination cycle, the final through hole drilling is performed in step 172. The final through hole drilling involves drilling holes through the entire PWB that have a second diameter, which is less than the first diameter described above. The through holes are then lined in the step 174. Preferably, the through holes are lined with copper. In other embodiments, the through holes can be plated with materials similar to those that can be used in the construction of the layers of metal. If a through hole passes through one of the filled clearance holes in a laminate, then the lining of the through holes are electrically isolated from the laminate in which the clearance hole is drilled. If a through hole does not pass through one of the filled clearance holes in a laminate, then the lining of the through holes is in electrical contact with the laminate.

Summary of amendments to claims

Claim 56 has been amended to claim a printed wiring board that includes:

at least one carbon containing layer;

at least one electrically conductive layer that includes at least one circuit;

at least one dielectric layer located between the carbon containing layer and the electrically conductive layer; and

wherein at least one electrical connection exists between the carbon containing layer and the circuit on the electrically conductive layer.

An embodiment of a printed wiring board in accordance with claim 56 is illustrated in FIG.10 and in FIG. 1A. The PWBs shown in both of these figures includes laminates that have carbon containing layers. The PWBs also include layers of metal or other electrically conductive material. The description accompanying FIGS. 10 and 1A points out that "at least one electrical connection exists between the carbon containing layer and the circuit on the electrically conductive layer"

None of the prior art references of record teach the limitations of claim 56, therefore, applicants respectfully submit that claim 56 is allowable.

Claims 57 - 66 and 72 - 74 are submitted patentable as dependent upon an allowable base claim. Claims 67 - 71 were cancelled as redundant in light of the amendments to claim 56. Claims 72 - 74 were added to claim the use of lined through holes to establish electrical connections as is illustrated in FIG. 10 and FIG. 1A.

Claim 75 claims a printed wiring board, comprising a layer containing carbon, wherein the layer containing carbon is a functional layer of the printed wiring board. Claim 75 is submitted to be patentable, because none of the prior art of

record teaches the use of a carbon containing layer as a functional layer within the printed wiring board.

Claims 76 - 79 are submitted patentable as dependent upon an allowable basis claim. These claims are also submitted to be allowable on the base that none of the prior art teaches the use of a layer containing carbon acting as a power plane and/or a ground plane.

Claim 80 - 84 are also submitted to be patentable on the basis that none of the prior art teaches the use of a layer containing carbon acting as a power plane and/or a ground plane.

On the basis that all of the claims satisfy 35 U.S.C. §112 and that the prior art does not teach the limitations of the pending claims, applicants submit that all claims are allowable and request the prompt issuance of a notice of allowance.

If applicants' counsel can be of assistance, please do not hesitate to contact us at the number listed below.

Respectfully submitted,

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